



Including the HES – Severe Weather / Mesoscale (SW/M) Task

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Outline

- **Addition of HES – SW/M as instrument**
- **Addition of HES – SW/M as capability to DS instrument**



Background

- **The point design instruments presented in the previous talk**
 - met the HES-DS task
 - did not accommodate the higher resolution needed by the NOAA's NWS for moisture variations (SW/M task)
- **HES-SW/M task**
 - Can be addressed by a separate instrument
 - HES-SW/M instrument
 - No tasking conflicts
 - Can be addressed by a combined instrument
 - One possible instrument solution is combining the HES-DS and the HES-SW/M tasks into the HES-DS/SW/M instrument.



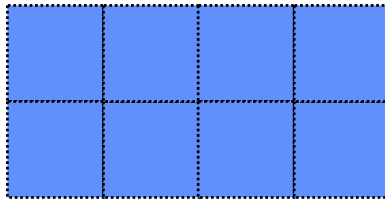
HES – SW/M met by a separate instrument

- This possible solution would look very much like the instruments to meet the HES-DS task
 - Performs similar soundings
 - Meets the same coverage rate
 - 1000 km x 1000 km in 4.4 minutes
 - GSR of 245 (TBR)
 - However, has finer spatial resolution
 - 4 km (Threshold) for SW/M vs. 10 km (Threshold) for DS
 - Impacts focal plane arrays
 - Increases data rate
 - Mass and volume are nominally the same as that for an instrument performing just the DS task
 - Mass ~ 185 kg
 - Volume ~ 1 m x 1 m x 1 m
 - Power increase due to additional pixels, increased electronics dissipation, and associate cooling.
 - Power ~ 235 W (interferometric in MIT-LL strawman, larger for grating)

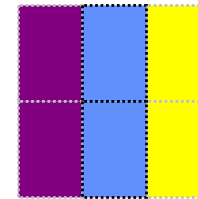


HES – SW/M met by a separate instrument (cont'd)

- Differences in the single instruments that perform the DS and SW/M tasks occur with the FPAs and associated processing.
 - Spatial pixels pitches that are 4/10 of those mapped by the same optics in the DS designs yield the requisite 4 km threshold



Interferometric



Dispersive

Blue shows active detection areas; Black dotted lines show 4 km regions

- Threshold Detector ensquared energy (DOEE) requirement has been reduced for the 4 km pixel.

DOEE is ratio of detected signal from geometric size of the sample to the detected signal from all other locations. It includes optical and electrical crosstalk.

For the 10 km threshold of the DS task, the DOEE is $\geq 90\%$ (Threshold)

For the 4 km threshold of the SW/M task, the DOEE is now $\geq 64\%$ (Threshold)

avoids the significant signal loss associate with decreasing the active detection area or aperture apodization



HES – SW/M met by a combined instrument

- Differences in the combined instrument that performs the DS and SW/M tasks occur with the FPAs and associated processing.
 - Large sampling of the DS task can be subdivided with smaller pixels in different ways
 - Option 1: 8 km on 10 km grid for DS, 4 km on 5 km grid for SW/M

Assume each gray region is an inactive region, present to provide higher ensquared energy as required for the DS task

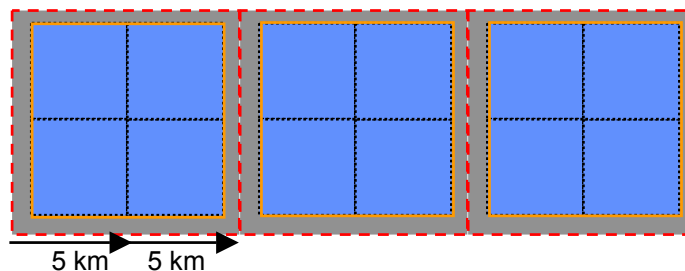
Technically challenging but method employed in interferometric ABS design

Blue shows active detection areas

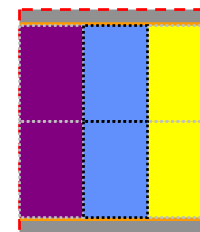
Black dotted lines show 4 km regions

Red dashed lines show 10 km regions

Orange solid lines show 8 km regions (8 km samples on 10 km spacing gives high DOEE).



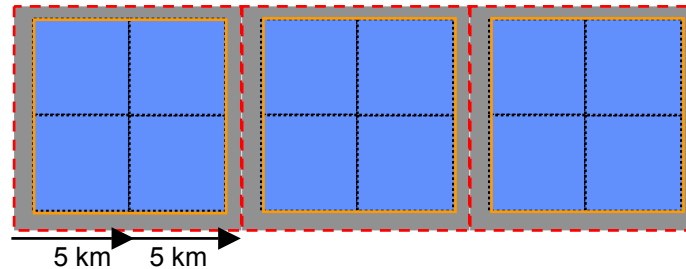
Interferometric



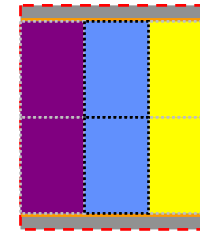
Dispersive



HES – SW/M met by a combined instrument (cont'd)



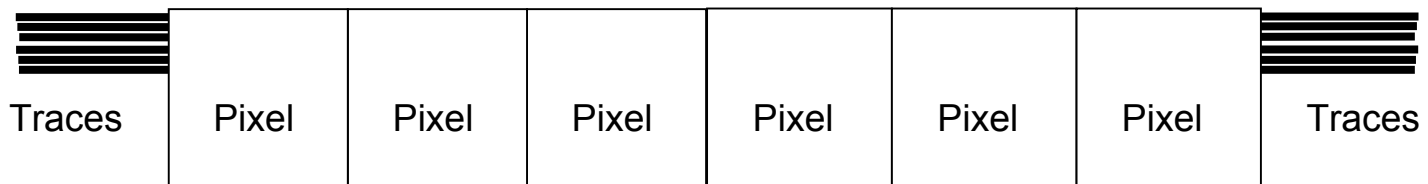
Interferometric



Dispersive

- Option 1: 10 km spacing for DS samples meets high DOEE but 4 km samples not centered on 5 km grid.

Either requires technology advancement (affecting access to “off-chip” capacitors) from level identified by study two years ago (described in the MIT-LL ABS interferometric point design)



Or significantly faster readout rates and more physical readouts for each pixel to handle the charge



HES – SW/M met by a combined instrument (cont'd)

- Option 2: 2 km spacing employing summing of the appropriate boxes for larger samples

Blue shows active detection areas

Black dotted lines show 4 km regions

Red dashed lines show 10 km regions

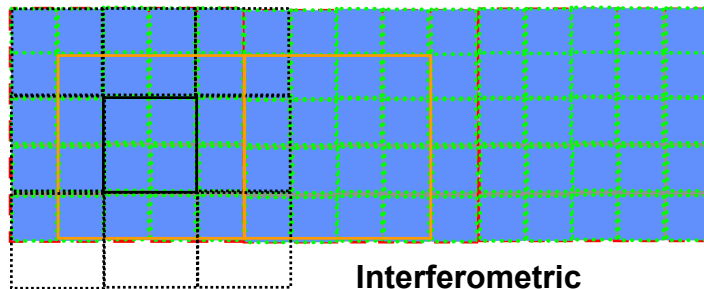
Orange solid lines show 8 km regions

Green dotted lines show 2 km regions

- Option 2 gives

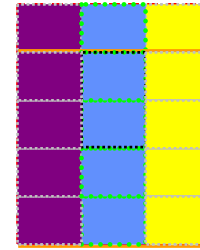
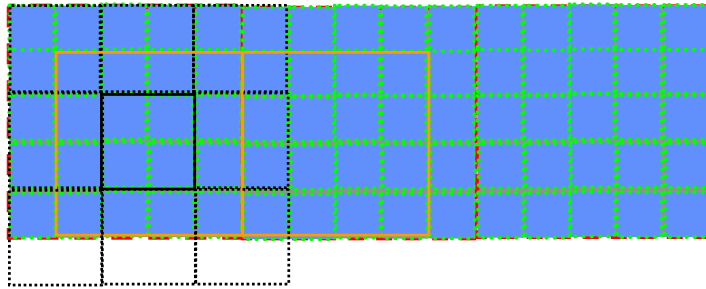
High DOEE from using 8 km x 8 km (4 x 4 samples of 2 km x 2 km) on 5 x 5 grid (dashed red) for DS task

Moderate DOEE from 4 km x 4 km (2 x 2 samples of 2 km x 2 km) on 4 x 4 grid (solid orange) for SW/M





HES – SW/M met by a combined instrument (cont'd)



- Important to note that this 2 km sampling does not achieve high ensquared energy on 2 km, because of the size of diffraction spot, and is thus not the 2 km spatial resolution of greatest interest to NOAA.

Summing to 4 km to meet the current DOEE requirement.

- However, it is a method by which contiguous 4 km or 8 km samples can be assembled in one possible combined instrument
- 2 km sampling system implications

non-linear affect related to decreasing pixel size

charge storage capacity decreases, which requires a further increase in readout capability

Significantly more readouts and more rapid readouts caused by having more pixels

more data processing capability, memory and more instrument power



Summary

- **Inclusion of SW/M capability can be obtained through either a single instrument or from combined instruments**
 - Even in the event of technology improvement, further study is required to validate the final acceptability to the users of the 4 km sampling on the irregular grid spacing presented (combined instrument option 1) here
 - Further study to validate the concepts of 2 km sampling presented here (combined instrument option 2).
 - Strawman (not a point design) implies NEdN performance can be met
- **The combined instruments discussed here are not the only combined instruments possible, and are not given any preference over others designs when reviewed by the government.**
- **4 km spatial sampling, when achieved, will fulfill NOAA's NWS need to look at small scale moisture variations.**